with fragments of it, which they have undertaken to examine; and I hope one or more of them will publish the results of their examination.

The fish of which it forms a part is at present unknown to naturalists; and therefore the name of *Myriosteon Higginsii* may be retained.

Since the above was written, Prof. Kölliker and Dr. Günther have sent me a preparation of the specimen mounted as a slide in Canada balsam; and they have no doubt it is part of a cartilaginous fish. They have now decided that it is one of the three or five bony tubes which strengthen and support the beak of the sawfish (*Pristis*), and thus confirm Mr. Carter's account; but how these tubes became so completely separated from each other and from the other bones of the beak is difficult to imagine, and shows the great power of the sun in tropical regions.

British Museum, April 7, 1870.

XLI.—*Researches on the Freshwater Crustacea of Belgium.* (Second and Third Parts.) By Félix Plateau*.

In the present day we have witnessed the appearance of many works on the freshwater Crustacea. In England especially we may cite the researches of Messrs. Baird, Lubbock, Brady, Norman, &c., a portion of which have been published in this journal. After these important memoirs and those relating to the same subject which have appeared in Germany, Sweden, and elsewhere, nothing remained for me, so to speak, but to glean the details which have been neglected by preceding carcinologists.

Genus *Daphnia*.—It seemed to me that it would be useful to make a complete study of the dermal skeleton of the *Daphniæ*, which has hitherto been very imperfectly known; I have endeavoured to apply to it the methods of analysis of MM. Milne-Edwards, Spence Bate, and others, and to compare it as far as possible with the cutaneous envelope of the Decapoda.

The body includes three parts—the head, thorax, and abdomen. The portion of the valves and of the test which covers the apparent head answers to the *carapace* or *scapular ring* of the higher Crustacea; the *cardiac region* is represented by the triangular piece which covers the heart, and the *branchial* region by the valves.

* Mém. de l'Acad. Roy. de Belgique, Mém. des Savants étrangers, tome xxxv. Abstract communicated by the Author.

The head has undergone a remarkable curvature, which separates certain parts and brings others nearer together. The cephalic ring presents the median region (stomachal region of Desmarest), covering the anterior part of the digestive tube; and we may recognize the existence of lateral regions. The facial regions are:—the *frontal* region, in the middle, much reduced in size and covering the organ of vision (it is developed into a rostrum only in *D. mucronata*); and the *orbital* regions on each side of this.

We may count as cephalic somites:—the first, characterized by the presence of the eyes; the second, by the antennules (*rami*); the third, by the antennæ (smaller antennæ of Strauss), and its posterior margin bears the labrum; the fourth is marked by the protognaths (mandibles), and bears the labium, whilst its hypertrophied epimera constitute the valves, as MM. Milne-Edwards and G. O. Sars have already shown.

The thorax, which, like a great part of the abdomen, is enclosed between the valves, includes six somites: there is a fifth somite bearing the deutognaths (maxillæ), and a sixth bearing the tritognaths (first pair of feet, of authors) and terminating the anterior pereion. The posterior pereion is formed by four somites, each bearing a pair of pereiopods.

The abdomen consists of six somites, namely:—the eleventh, twelfth, and thirteenth; the fourteenth, provided with mamillæ which close the incubatory cavity; the fifteenth, bearing the caudal setæ; and the sixteenth, or last, which is a true *telson*.

Hitherto we have had scarcely any exact data as to the moulting of the Cladocera. I have been able to observe this phenomenon in the female of *D. mucronata*. A long transverse fissure is formed along the branchio-cardiac furrow which separates the valves from the head; and the scapular buckler splits along the median line or dorsal crest of the valves. The head bends down in front, and a new cephalic extremity makes its appearance towards the back through the transverse fissure. The *Daphnia* shakes itself rapidly; the antennules escape from the old ones as if these were actual sheaths; then the animal, by a few last efforts, finally escapes from its old skin through the longitudinal opening of the crest of the valves. The phenomenon takes place with extreme rapidity, the whole change only lasting two seconds.

The circulatory apparatus presents some curious peculiarities. Thus the venous sinus which surrounds the heart is by no means always circular, as has been supposed. In *D. pulex*, when seen from the dorsal surface, it is polygonal, with seven

sides; at each systole these seven faces become strongly concave, at each diastole they return to their rectilinear form.

I have found in Belgium seven species of *Daphnia*, a single *Bosmina* (*B. longirostris*, Baird), and a single *Polyphemus* (*P. oculus*, Müll.). The last is excessively rare.

Copepoda.—I have made the following observations upon the dermal skeleton. M. Leydig has stated that the cuticle (epidermis) contains no calcareous deposit; I have demonstrated its presence chemically. The canals which traverse the cuticle in the higher Arthropoda are visible here only at the posterior margin of certain thoracic segments. The material which colours the skin is situated in the soft non-chitinous membrane (corium), and is of a granular nature. The animal probably lives at its expense during periods of forced abstinence from food; for, according to my experiments and those of M. Zenker, the colour disappears when the animal is made to fast. The blue or green colouring-substance undergoes no change by the action of bases; it becomes reddish by the action of acids, and in this case bases do not bring it back to its original tint.

The Copepoda are often indebted for other colours to their residence in naturally coloured waters. Following the example set by B. Prévost with other animals, I put some Cyclopidæ into water reddened by carmine; in the course of six days they acquired a rose-colour, and the colouring-matter was to be seen in the digestive tube, in the envelope of the oviferous sacs of the females, and in the interior of the bodies of the parasitic Infusoria. All these observations prove that in this group of Crustacea, notwithstanding the contrary opinion of Müller, colour can never be regarded as a specific character.

The dermal skeleton of the genera *Cyclopsina*, *Canthocamptus*, and *Cyclops*, when subjected to the same analysis as that of the *Daphniæ*, shows six cephalic somites (of which the tergal portions become amalgamated to form a carapace), four thoracic somites, and six abdominal somites, including the *telson*. The appendicular organs are—a pair of antennules, a pair of antennæ, a pair of protognaths, three pairs of maxillipeds, four pairs of thoracic feet or pereiopods (each including an endopod and an exopod), and, lastly, a pair of uropods.

The muscular system, which is highly developed, merited a careful examination. Histologically the muscles are like those described by M. Leydig in *Branchipus*; that is to say, they are composed of a transparent envelope and a contractile sarcode consisting of cuneiform elements closely interlaced. For

the sake of brevity, I shall not reproduce the description of the musculature of the body; but I may indicate one peculiarity: in the antennæ, the perciopods, and the uropods, whilst we see in each moveable joint a flexor muscle, we always find as its antagonist a large transparent elastic cylinder, without any striæ, and presenting here and there a few brilliant nuclei. This is perhaps the very elongated prolongation of a very short muscle.

Notwithstanding what has been said, *Cyclopsina castor* always swims with the ventral surface downwards. *Canthocamptus staphylinus* swims with the tail as a continuation of the body, and only elevates it when moving upon the glass plate of the microscope. Natation is effected solely by the antennules, and the perciopods merely enable the animal to maintain its position in the midst of the liquid. The Copepoda possess a density higher than that of pure water. When recently killed, they fall to the bottom of the liquid at the rate of 5 millims. per second.

The presence of an optic ganglion for each eye is the only new point that I have ascertained with regard to the nervous system. I have reobserved the curious sleep of the Cyclopidæ spoken of by M. Zenker.

When submitted to the discharge of a Leyden jar of 1 litre capacity, these little animals fall to the bottom of the water as if thunderstruck; but, singularly enough, in an hour they recover from this stupefaction, and swim about again with vivacity. There is some analogy between these results and those recently obtained by Dr. Richardson, who saw a pigeon and a toad resist the shock of a spark more than 70 centimetres in length, produced by the colossal induction-coil of the Polytechnic Institution*.

With regard to the digestive apparatus, I observed on the inner surface of the *tunica propria* of the first part of the intestine a layer of enormous, transparent, cylindrical epithelial cells, which probably bear vibratile cilia. I was led to this last supposition by the characteristic rotatory movements undergone by particles of alimentary substances in the intestine of a *Cyclopsina*. If my observation were confirmed, it would prove that vibratile cilia may exist in the digestive tube of the Articulata (leaving the Rotatoria out of the question).

A series of experiments made simultaneously upon *Cyclops quadricornis* and *Daphnia simus*, with regard to the influence of sea-water upon these animals, gave me the following results. The *Cyclops* dies in sea-water in a few minutes; the

* Le Cosmos, October 23, 1869, p. 443.

Daphnia resists its action scarcely for a quarter of an hour. M. Paul Bert ascribes the death of sea-fish in fresh water to the difference of density, of osmotic power, and of the power of holding oxygen in solution possessed by the two liquids. Now these small Crustacea do not as yet verify this supposition; for they continued living for eight days and more in a solution of sugar of the same density as sea-water. From my investigations it would appear that we must attribute the death of the Cyclopidæ and *Daphniæ* in sea-water to some of the salts which that water holds in solution. By employing them alone and separately, in the proportions in which they exist in the water of the ocean, we find that the chlorides of sodium and magnesium act like true poisons, and that sulphate of magnesia has no action.

It was supposed until very lately that *Cyclops quadricornis* had no heart. Nevertheless a heart exists in it, and is of a pyriform shape, slightly constricted in the middle, with its broadest end in front. The only aperture I have been able to distinguish in it is a venous fissure at the antero-superior part. Whilst the heart of *Cyclopsina castor* is situated under the first thoracic ring, that of *Cyclops quadricornis*, on the contrary, is near the extremity of the sixth cephalic somite. It beats very slowly.

I have entirely passed over the internal reproductive organs, and only attended to the genital apertures, which are less known.

In *Cyclops quadricornis* the female genital orifice opens on the ventral median line, in the furrow which separates the last thoracic from the first abdominal somite. The last thoracic somite forms its upper lip, and is moved by special muscles. Its lower lip belongs to the following segment.

The investigation of the mode of formation of the oviferous sacs has enabled me to ascertain that the elongated secretory organ lodged in the first and second abdominal segments, and opening at the vulva, is not devoted to the secretion of the sacs, but is a seminal receptacle. The true secretory organ of the oviferous sacs consists of two curved glandular cæca situated beneath the skin of the first abdominal somite. Although at first very indistinctly visible, these glands by degrees acquire more distinct outlines. When the female is fecundated, the seminal receptacle, which is enormously swelled, ascends entirely into the first segment of the abdomen, which it fills up, and at the same time pushes upward the glands just mentioned. These glands, the volume of which has increased at least a hundredfold, extend themselves laterally to the epimera. On each side we find an aperture, which has long been known,

between the epimeron and the corresponding episternal piece; each of these apertures bears an oviferous sac. The glands can secrete the two sacs in less than ten hours.

In the genera *Cyclopsina* and *Canthocamptus* the female aperture is situated upon the boundary between the first two abdominal segments. The reservoir and the two glands exist as in *Cyclops*; but here the orifices of the glands open at the vulva, which bears directly the single oviferous sac.

The oviferous sacs are secreted by layers one *within* the other; the bottom has only a single layer.

In the male *Cyclops quadricornis* there are not, as has been supposed, two genital apertures at the angles of the last thoracic somite, although two organs producing the spermatophores actually exist there; but there is only a single orifice, in the form of a fissure, at the posterior margin of the first abdominal somite.

Like the Cladocera, the Copepoda propagate with great rapidity. *A priori* one might suspect in them an apparent or actual parthenogenesis; but my experiments show that young animals isolated immediately after hatching never reproduced, nor did females sequestered after their first oviposition ever produce new oviferous sacs and new eggs. Moreover, in a state of nature, the males are sufficiently common to render parthenogenesis quite unnecessary for the preservation of the species.

XLII.—*Note on* Polytrema miniaceum.
By Prof. G. J. Allman, F.R.S.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,

Among the most abundant products of the dredge on the coast of Mentone is a little, red, branched, coral-like body which attaches itself to various objects brought up from moderate depths. It is so conspicuous that it must be familiar to most naturalists who have studied the fauna of the Riviera, and was long ago described by Risso under the name of *Polytrema corallina*; while, as De Blainville has pointed out, it appears to be identical with the *Millepora miniacea* of Linnæus, whose specific name it must therefore receive.

With the exception, however, of some suspicions of its rhizopodous affinities entertained by Gray and by Dujardin, its real nature appears to have been entirely misunderstood, systematic writers having placed it either among the true